NO_2, SOA precursor gases and aerosol extinction measured by ground MAX-DOAS during CALNEX and CARES

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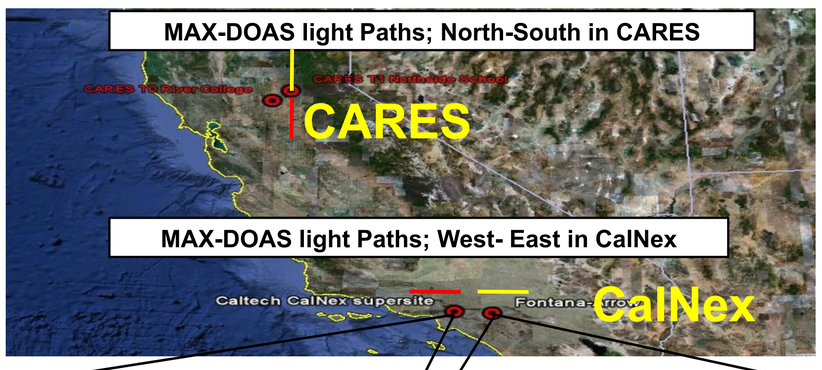
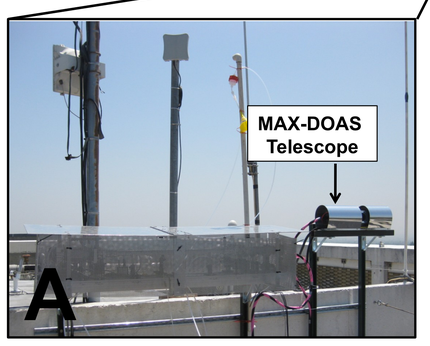
Introduction

We present results from two ground-based University of Colorado Multi Axis Differential Optical Absorption Spectroscopy (CU-MAX-DOAS) instruments deployed during the CALNEX 2010 and CARES field campaigns. Ground based CU-MAX-DOAS measurements were carried out to measure vertical column abundances, and investigate vertical distributions of Secondary Organic Aerosol (SOA) precursors such as glyoxal (CHOCHO), radical sources (HONO, HCHO), NO_2 and aerosol extinction (determined indirectly with the oxygen dimer O_4), The measurements were acquired during CalNex on the top of Millikan library at Caltech, Pasadena, CA, as well as at the Fontana Arrows site located 60 Km east of Caltech and at T1 site during CARES. First results are presented for NO_2, HONO, CHOCHO, HCHO, and aerosol optical depth, and their horizontal gradients are discussed.

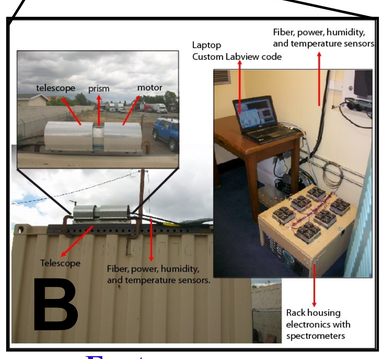
Ground-based CU-MAXDOAS

Caltech/Top of the Millikan library (figure A)	Fontana Arrow (figure B)/ T1 site CARES (no picture)
15 May – Nov 2010	15 May-Nov 2010/11 to June 28 2010
1˚,3˚,6˚,10˚,20˚, 30˚, 45˚ and zenith	
east-west	east-west / north-south
325-492 nm, 0.7 nm FWHM	3 spectrometers, 300-631 nm, 0.4-0.6nm FWHM





Top of Millikan library

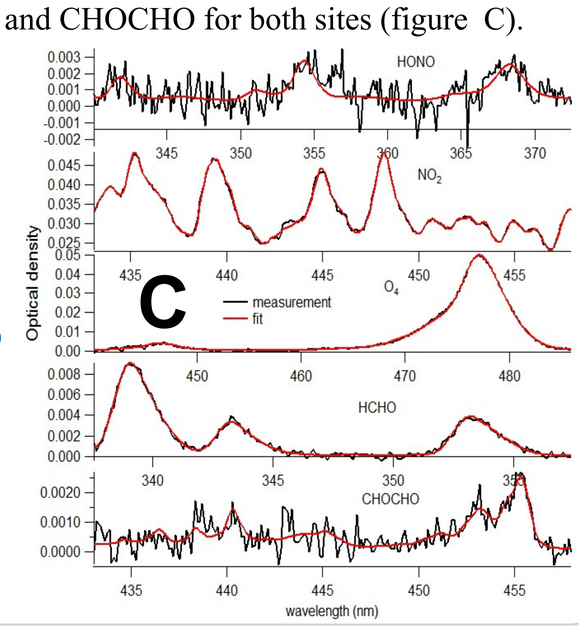


Fontana arrow

MAX-DOAS Analysis

- Spectra were analyzed with the DOAS method in order to obtain differential Slant Column Densities (dSCD) for HONO, NO_2, O_4, HCHO, and CHOCHO for both sites (figure C).

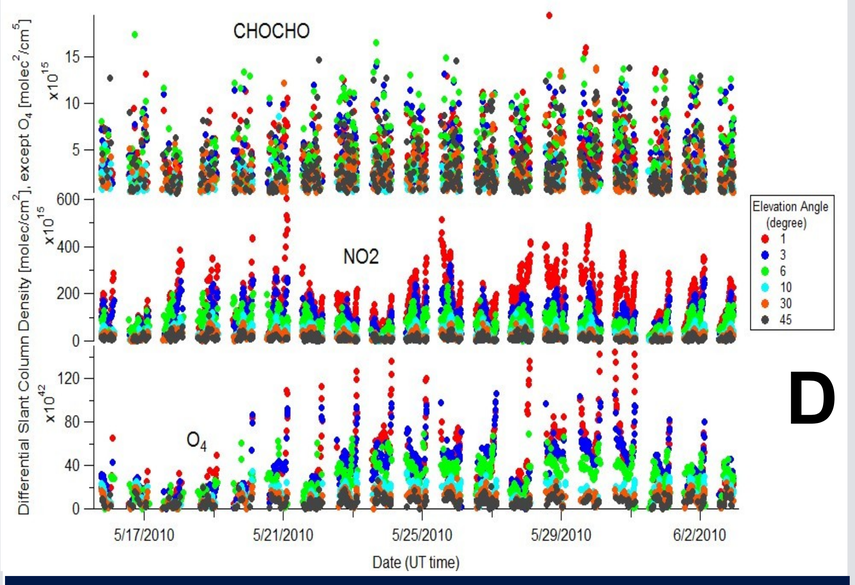
SCDs are column densities of an absorber along the path of the scattered light from the sun to the telescope; *differential* means with respect to a reference spectrum.



CalNex results

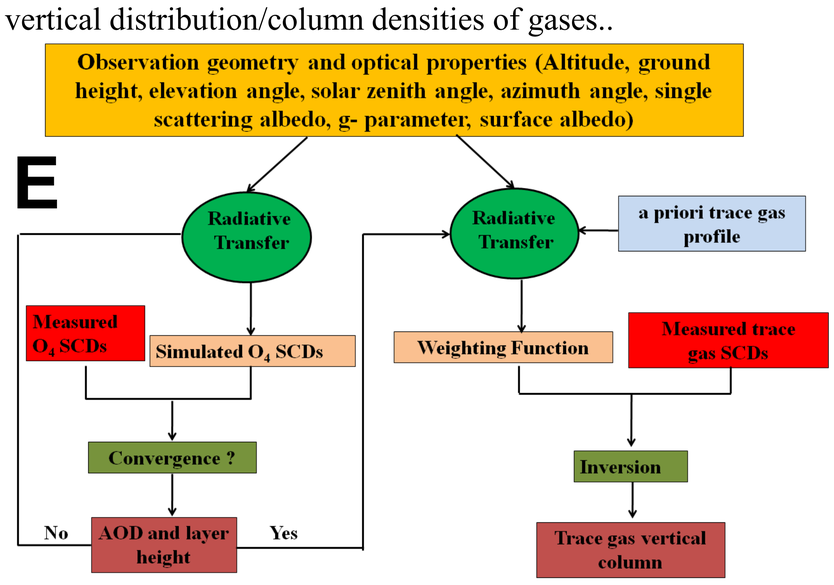
Times series

NO_2, CHOCHO, and O_4 dSCDs are shown in figure D for the first two weeks of CalNex (significant data). Different colors represent different elevation angles (angle above the horizon) for the west direction.

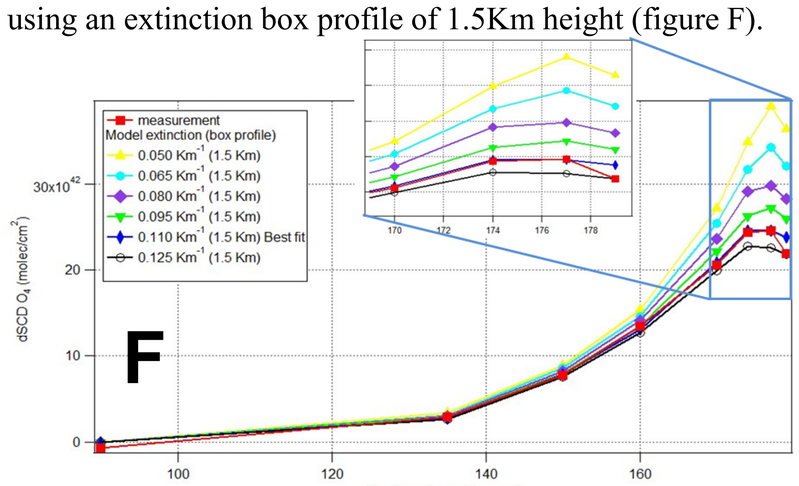


Aerosol Optical Depth (AOD)

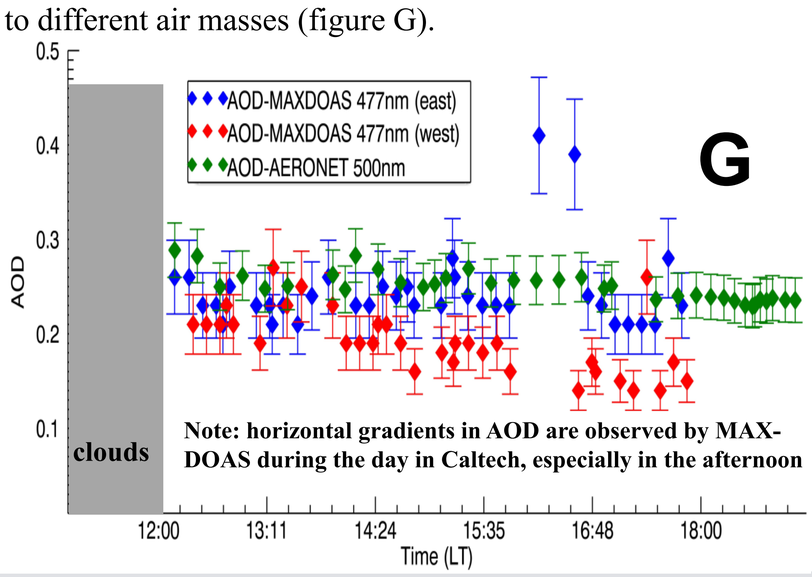
- Figure E shows the procedure followed to retrieve AOD and vertical distribution/column densities of gases..



- Example for measured and modeled O_4 dSCDs for 1 scan using an extinction box profile of 1.5Km height (figure F).

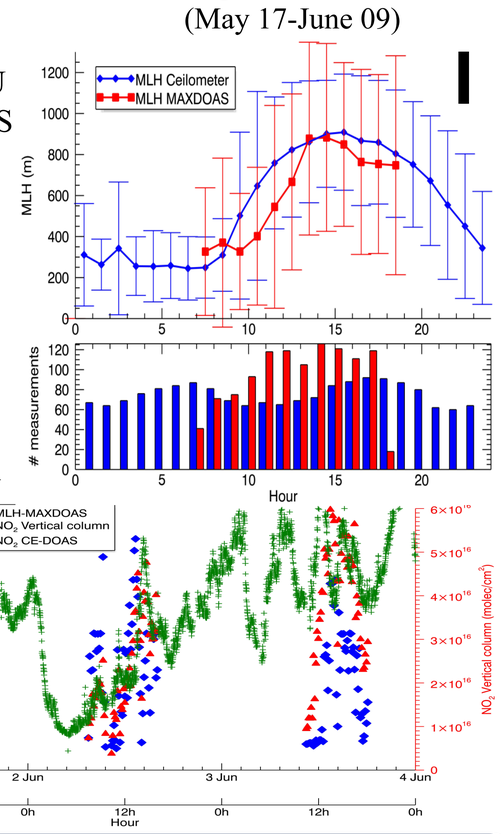


- AODs have been retrieved for 26 June from the CU MAX-DOAS and compared to the AERONET station at Caltech.
- East and west directions show distinct differences in AOD due to different air masses (figure G).



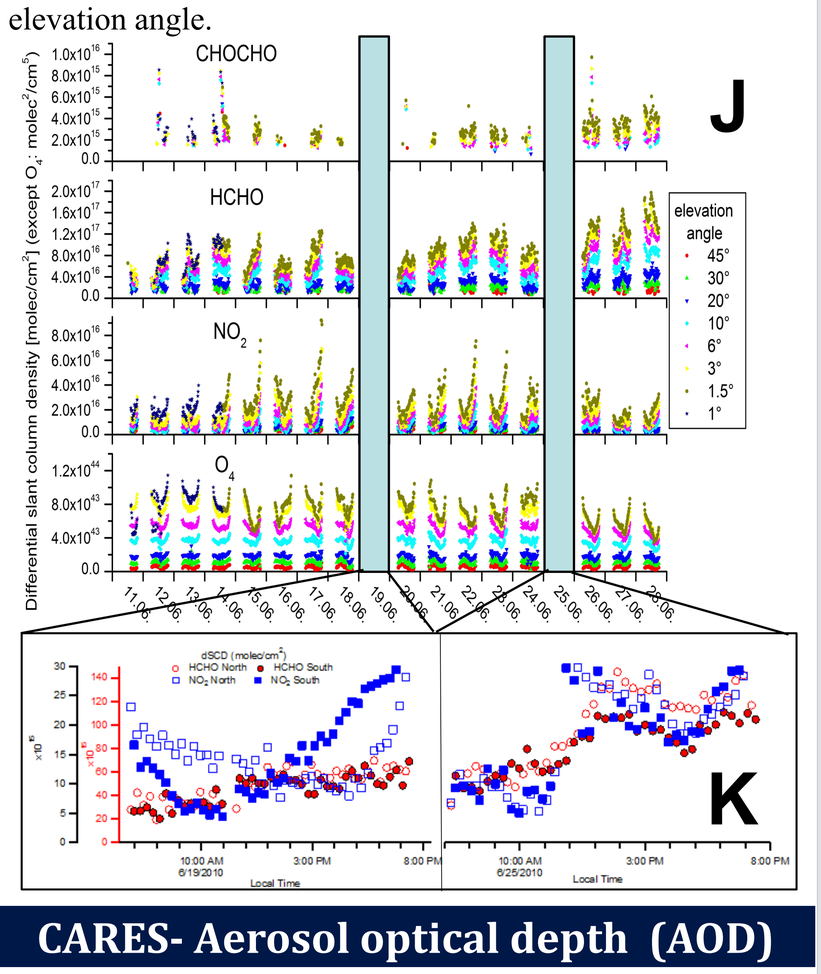
Retrieval of the Mixing Layer Height (MLH) and NO_2 vertical columns

NO_2 volume mixing ratios (VMR) measured with the CU cavity enhanced DOAS and vertical columns (VC) retrieved for the east-facing telescope (figure H) are used to retrieve the MLH (figure I). The equivalent NO_2 MLH was calculated as MLH = VC / ρ_{air}VMR



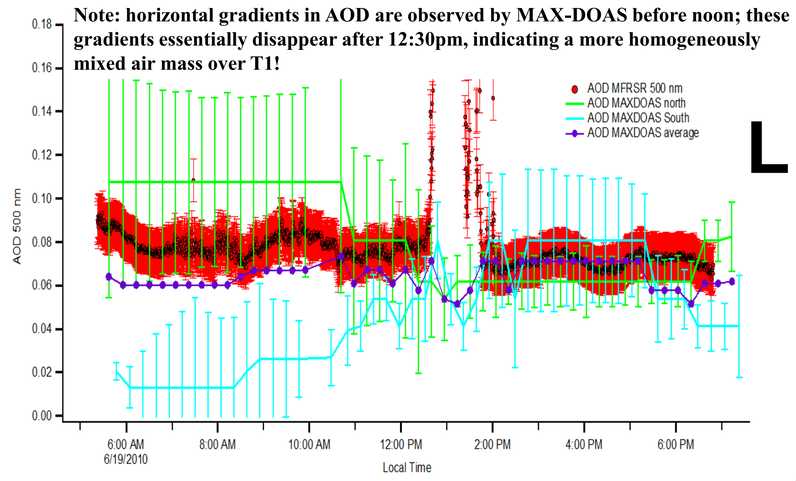
CARES-times series

- Time series of dSCDs trace gases during CARES are shown in figure J for the duration of the campaign.
- Figure K shows the differences in trace gases observed for two days for the north and south air masses for the 3˚ elevation angle.



CARES- Aerosol optical depth (AOD)

AODs have been retrieved for 19 June from the CU MAXDOAS and compared to MFRS (figure L).



Acknowledgements: *This work is supported by NSF-CAREER award ATM-0847793 and California ARB project 09-317.*